



NTSB National Transportation Safety Board

Office of Highway Safety

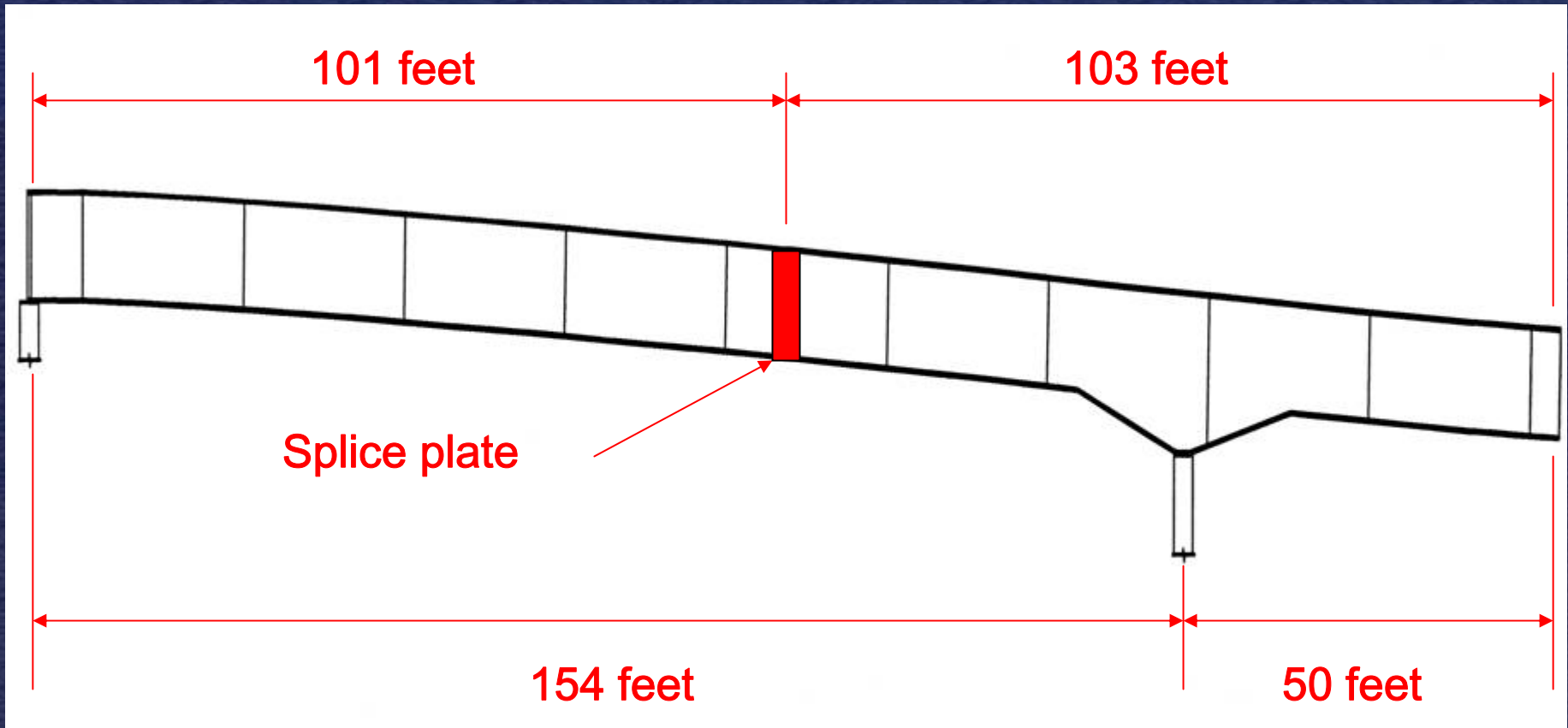
Girder Failure

Dan Walsh

Introduction

- Erection of the girder and installation of the bracing were inadequate
- Resulted in an insecure bracing arrangement

Girder Properties



Source: Colorado Department of Transportation

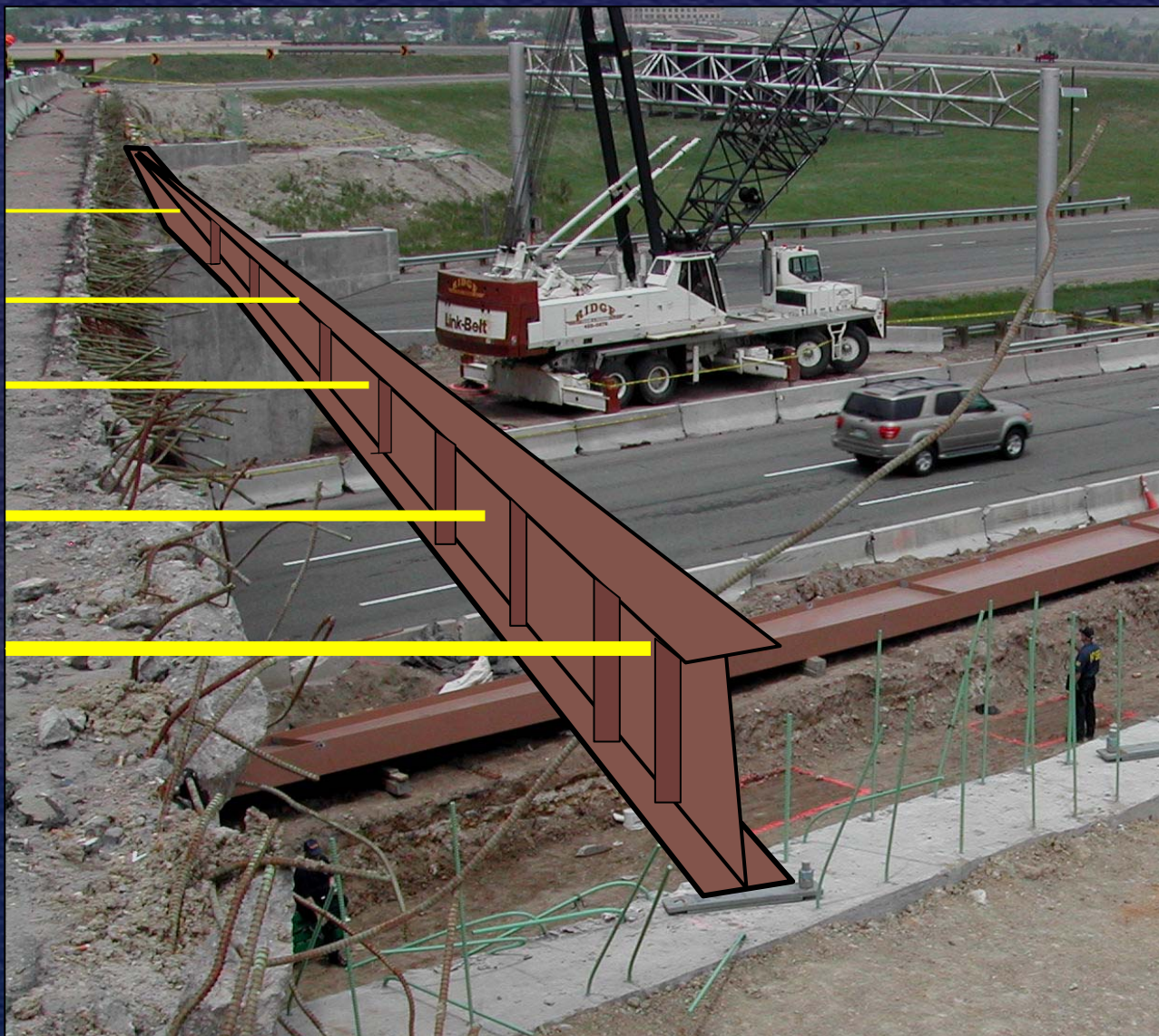
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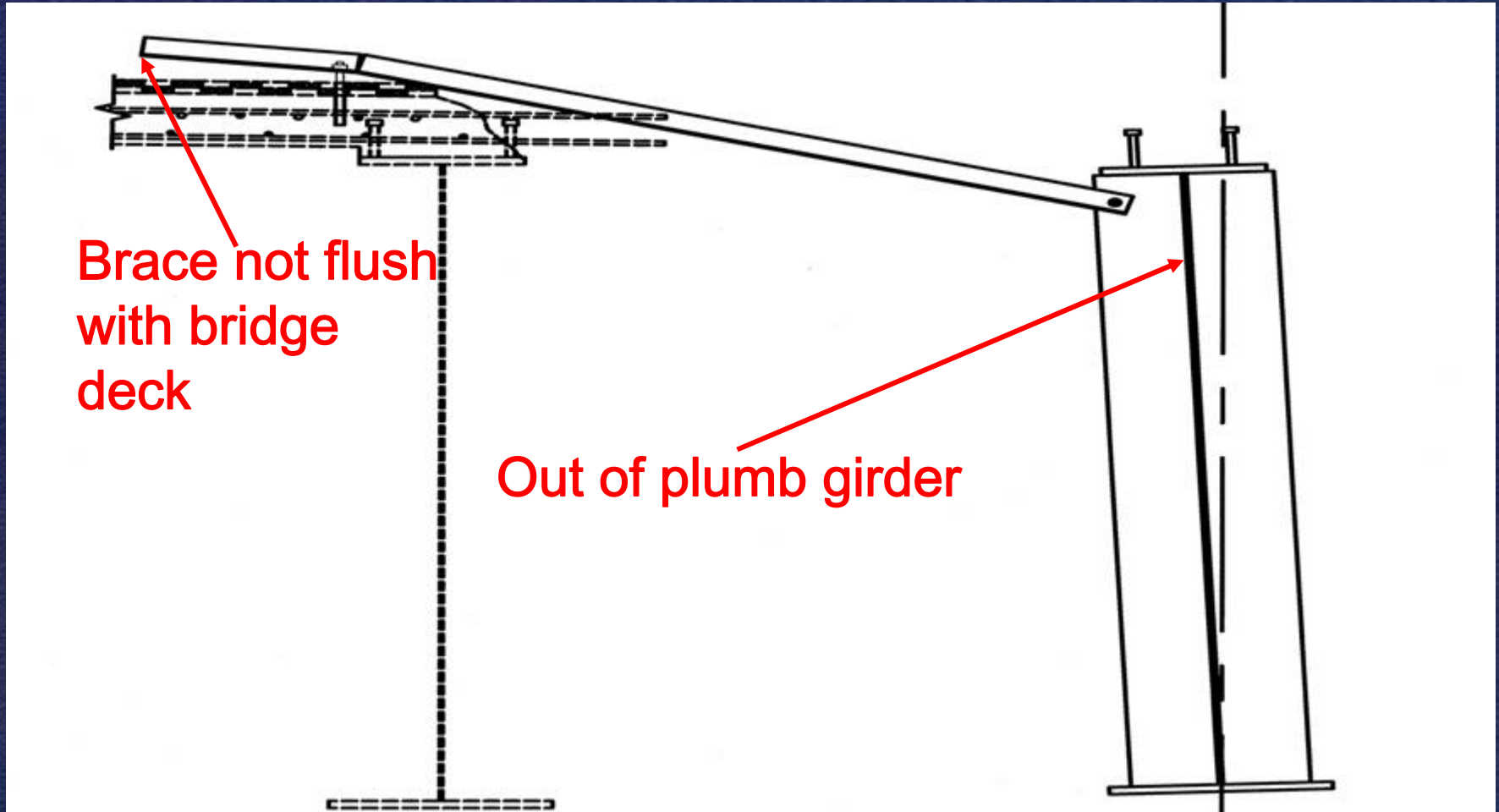
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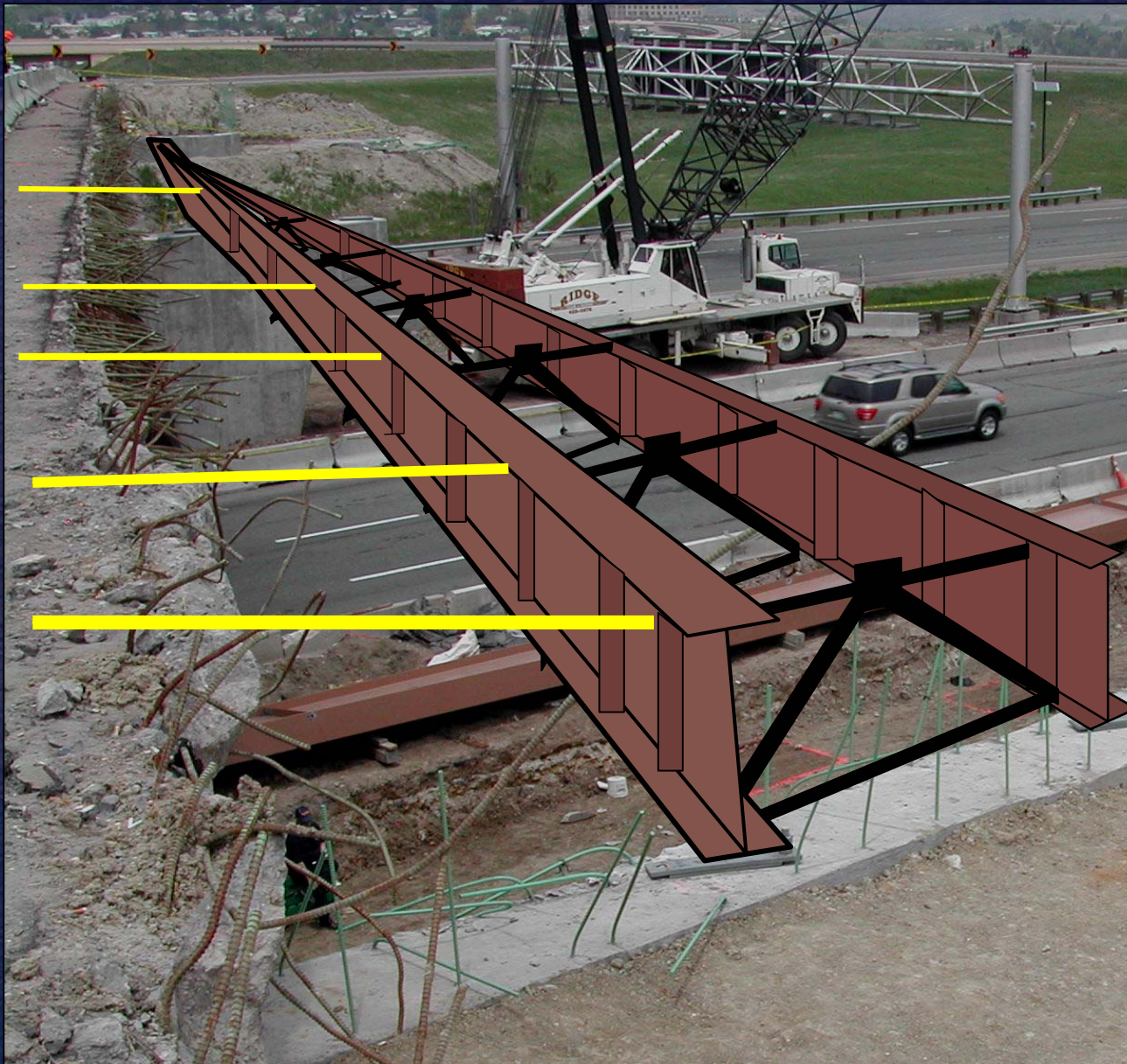
Lateral Brace 5 and Bolt



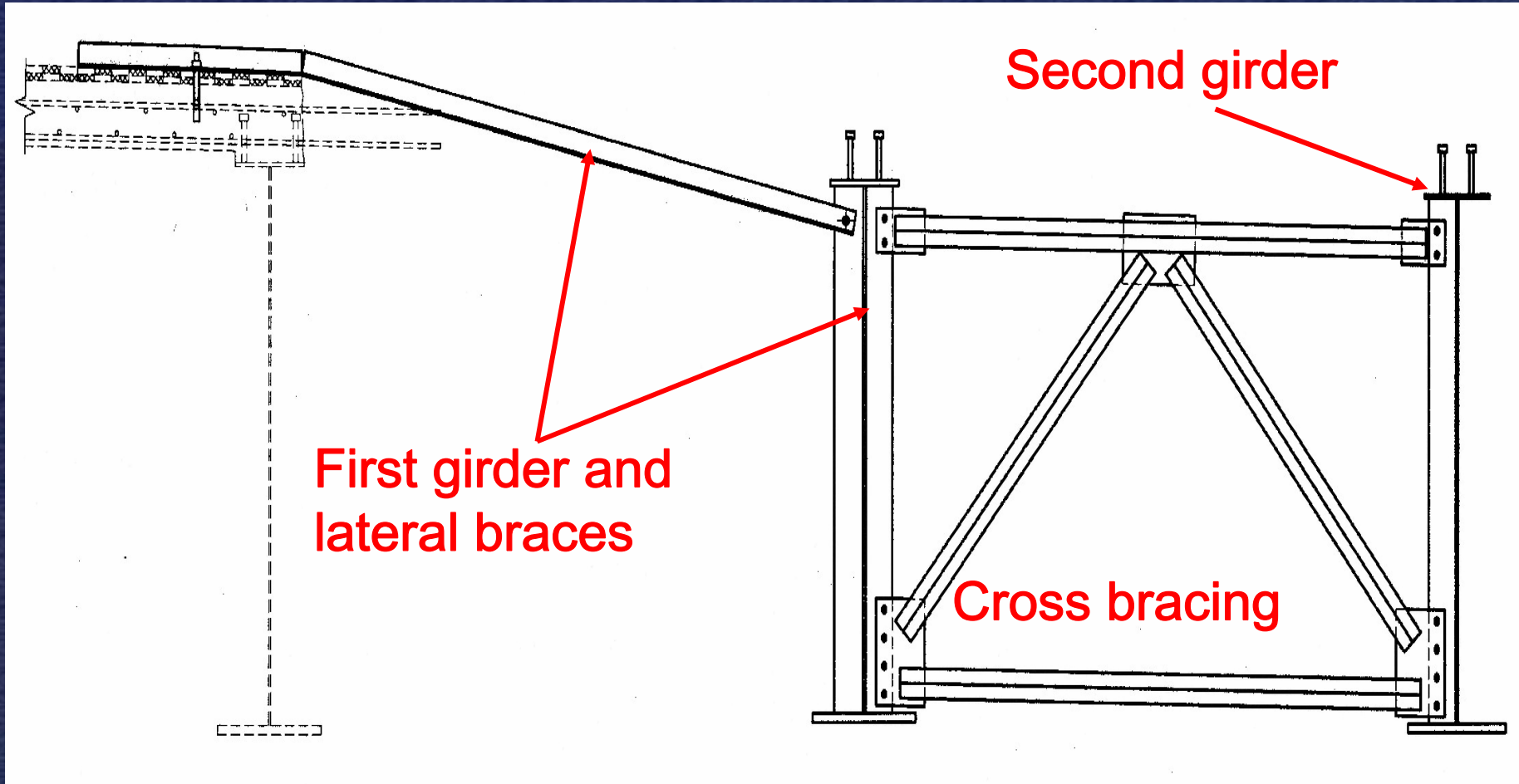
Improper Construction Methods



Source: Colorado Department of Transportation



Install Two Girders



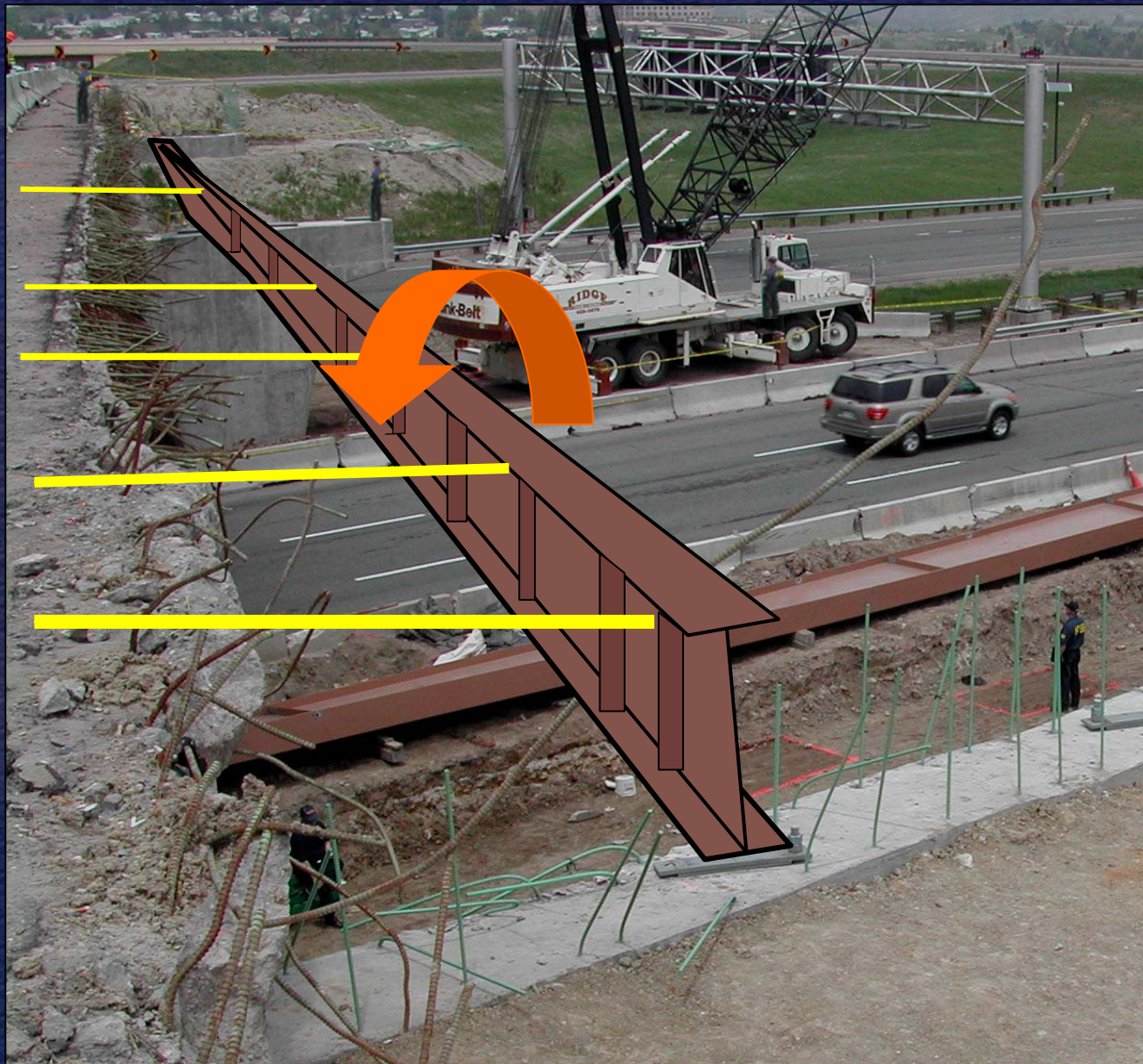
Source: Colorado Department of Transportation

Reasons for Girder Failure

- Out-of-plumb girder
- Lateral braces not flush with existing bridge deck
- Bolts not installed to manufacturer installation requirements
- Diameter of hole larger than diameter of bolt

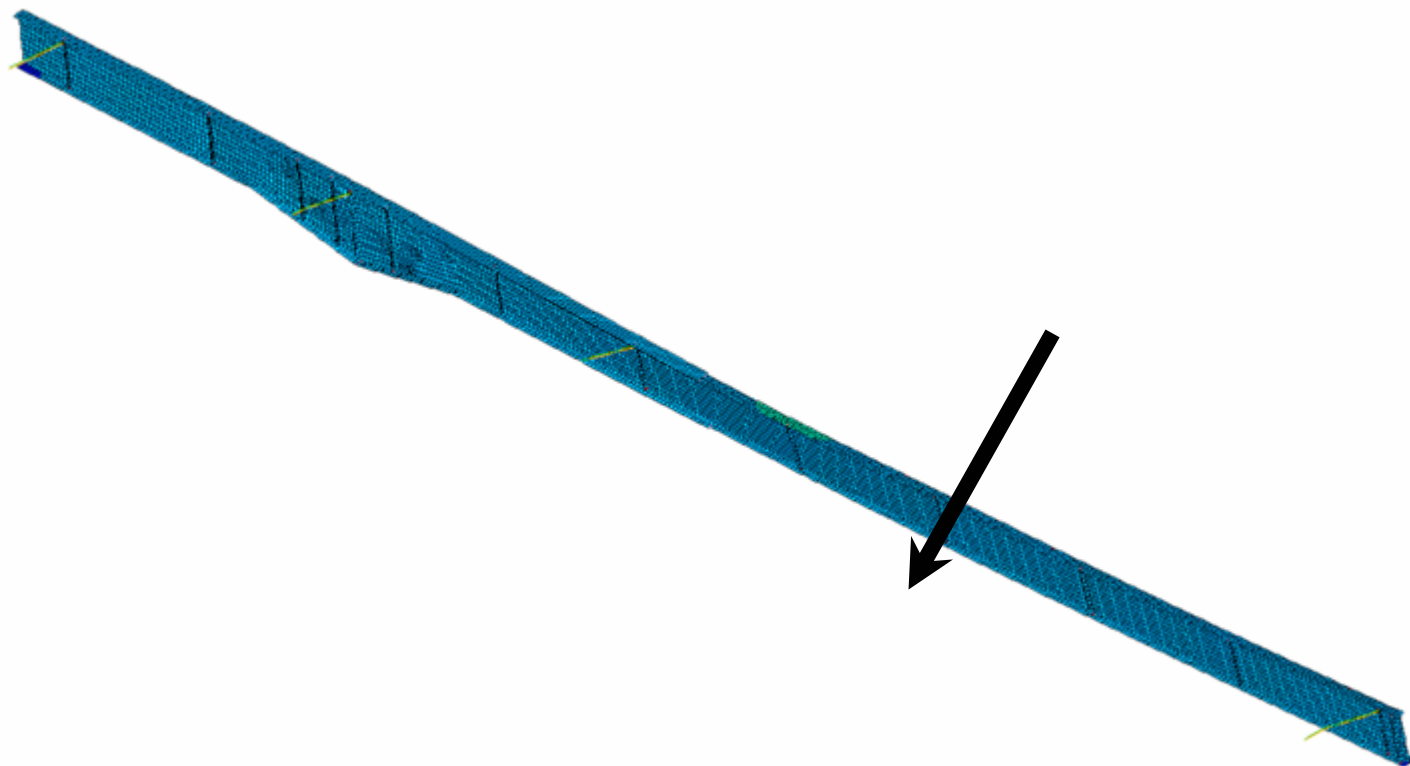
Finite Element Analysis

- FHWA Turner-Fairbank Highway Research Center
- Various combinations of braces were removed
- Brace 2 was the most critical to providing stability



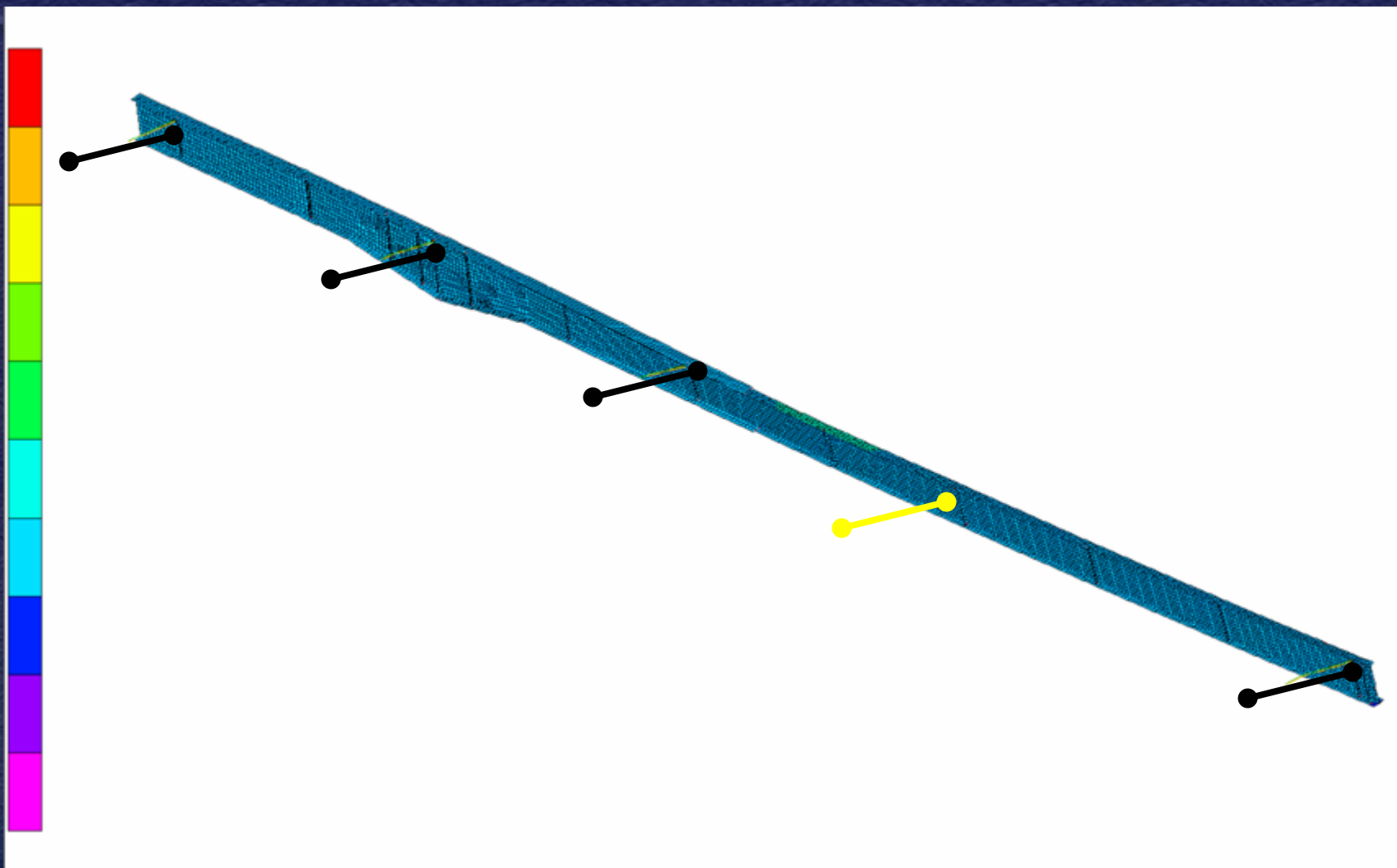
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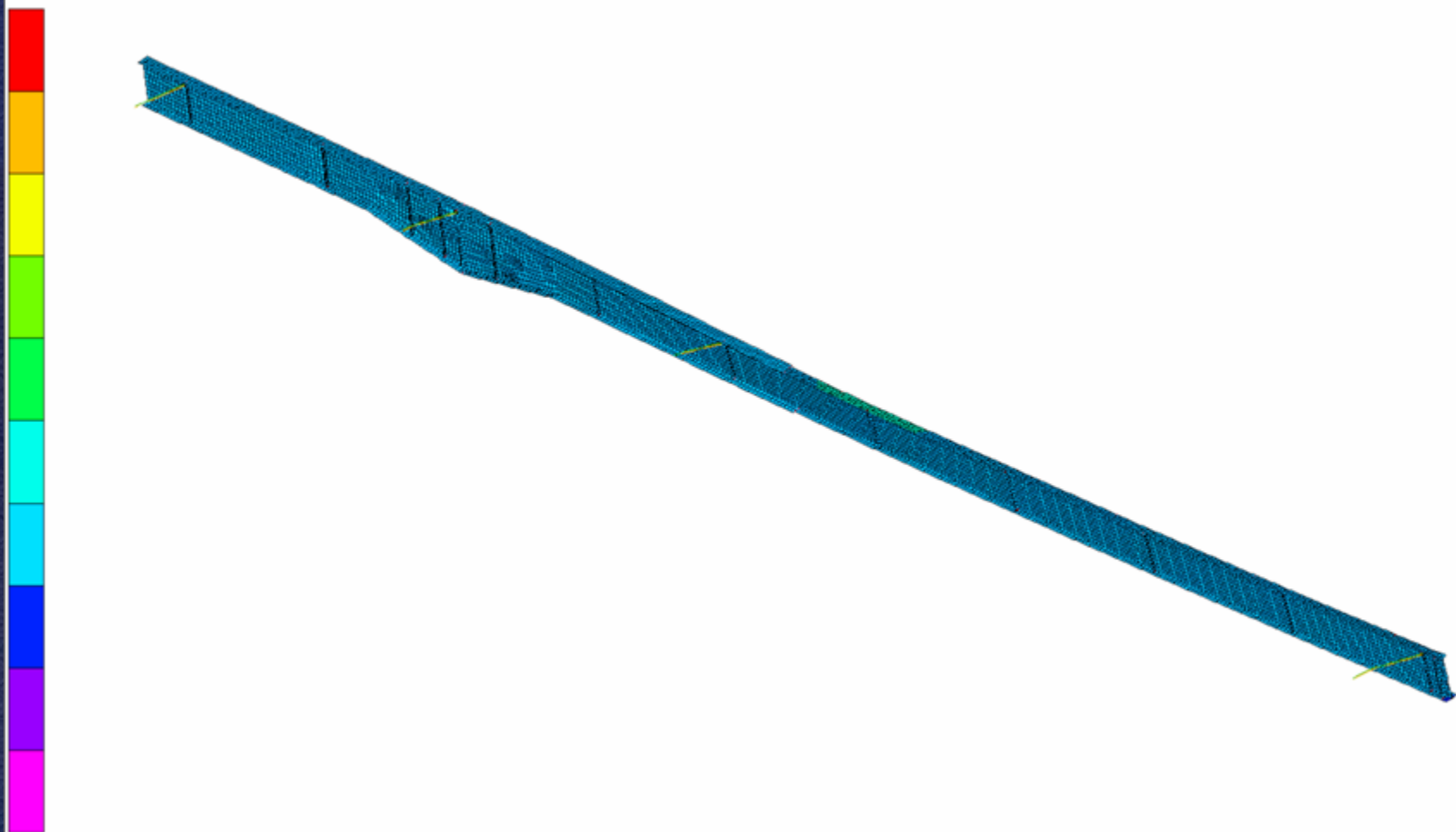


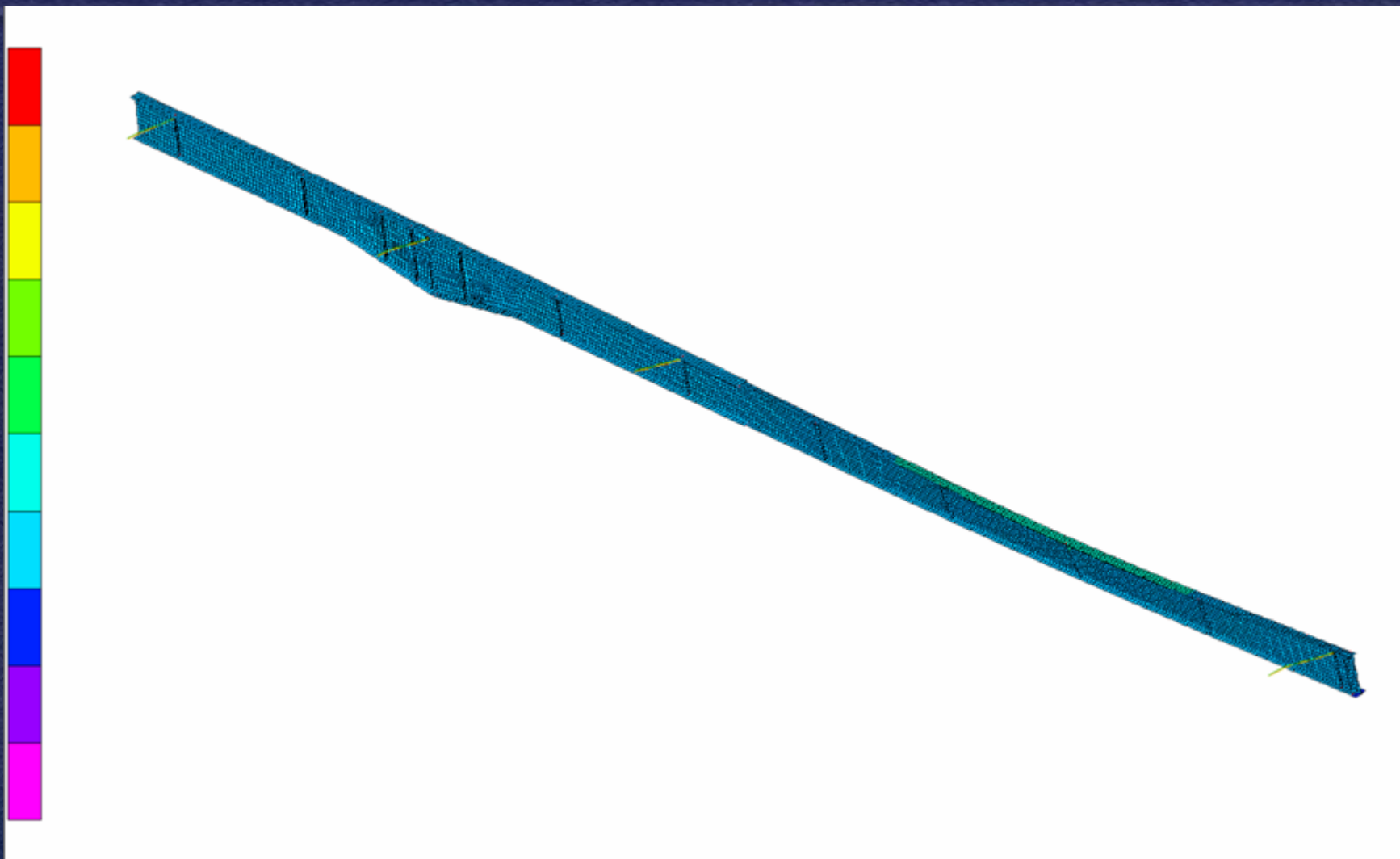


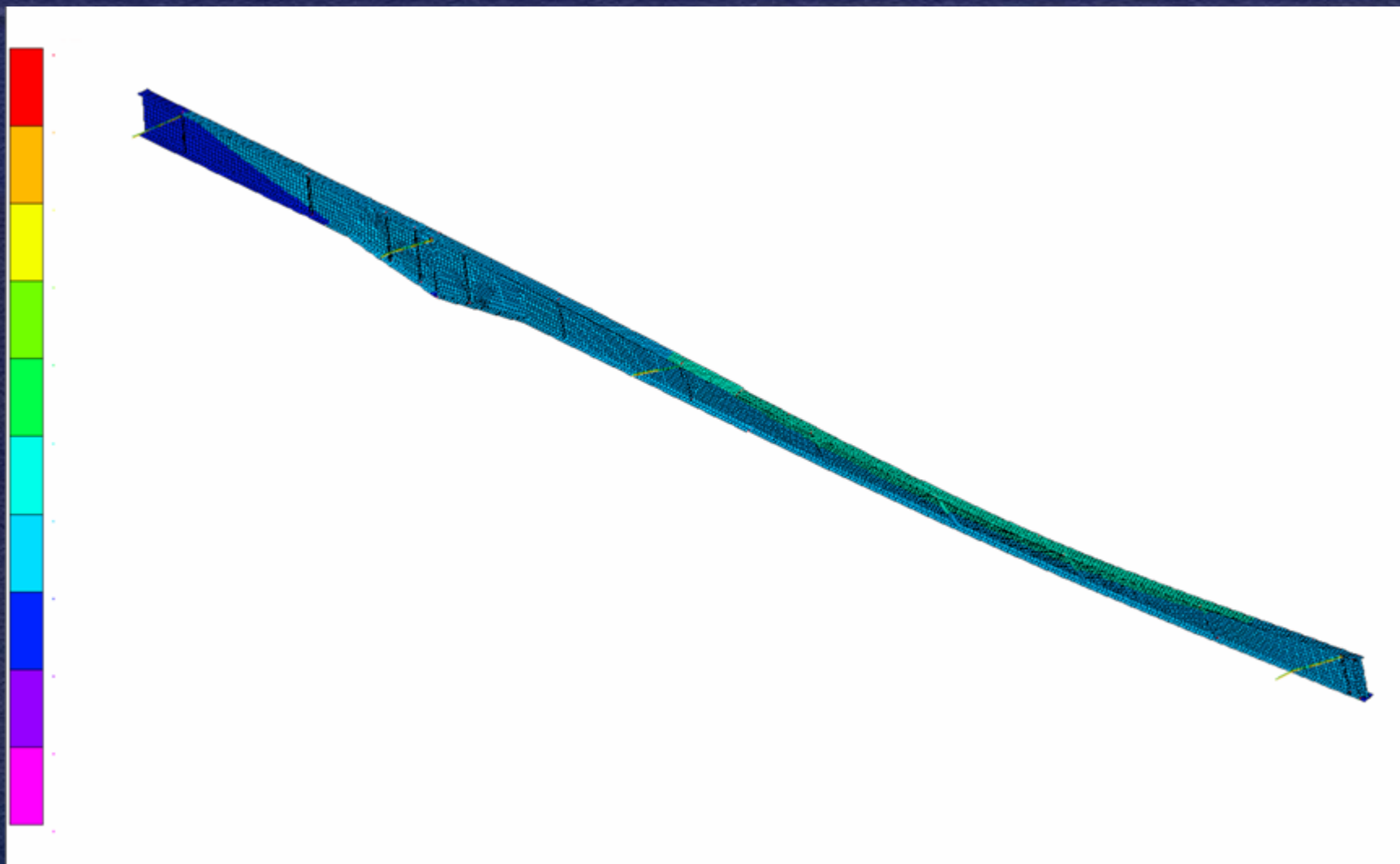
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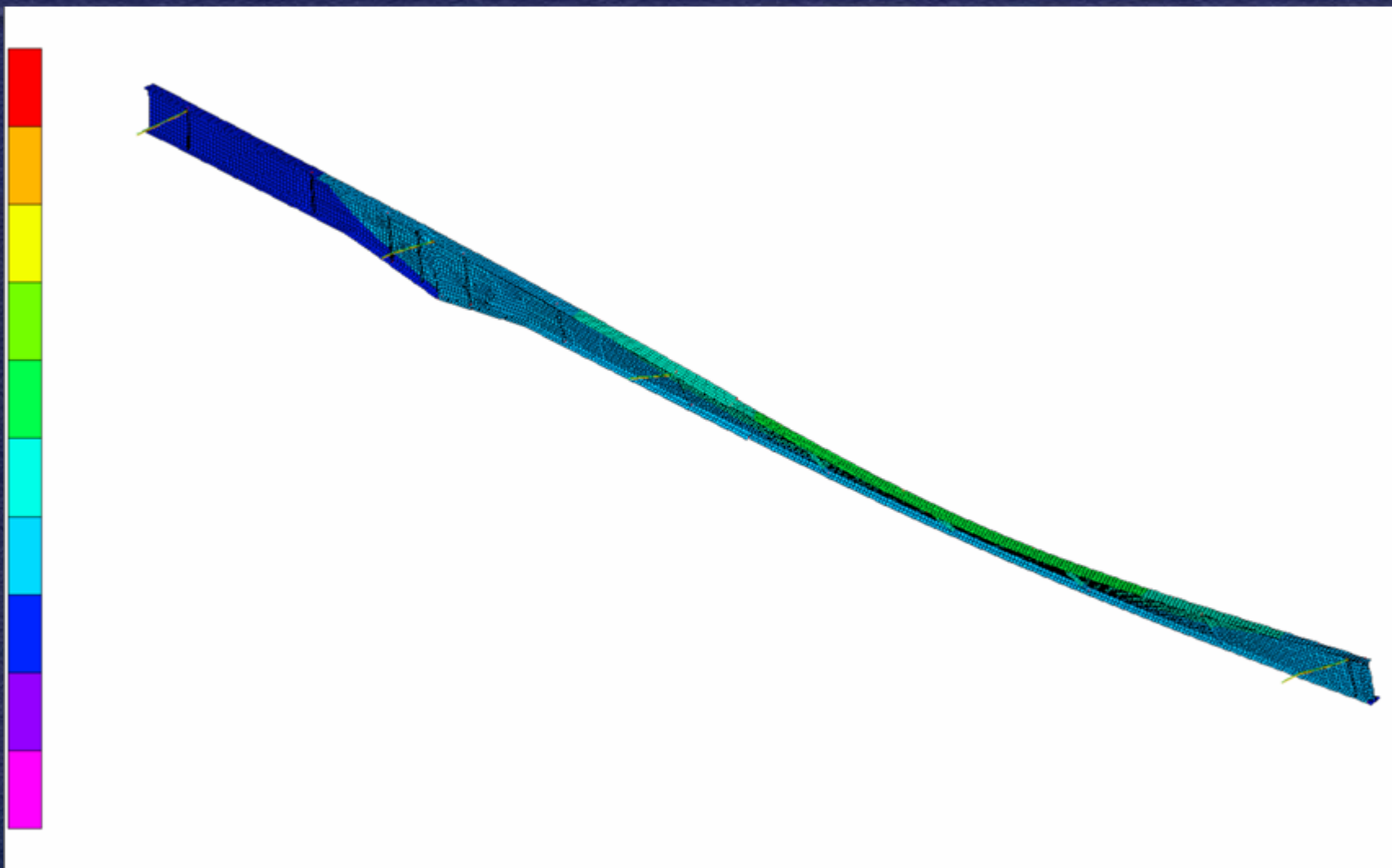


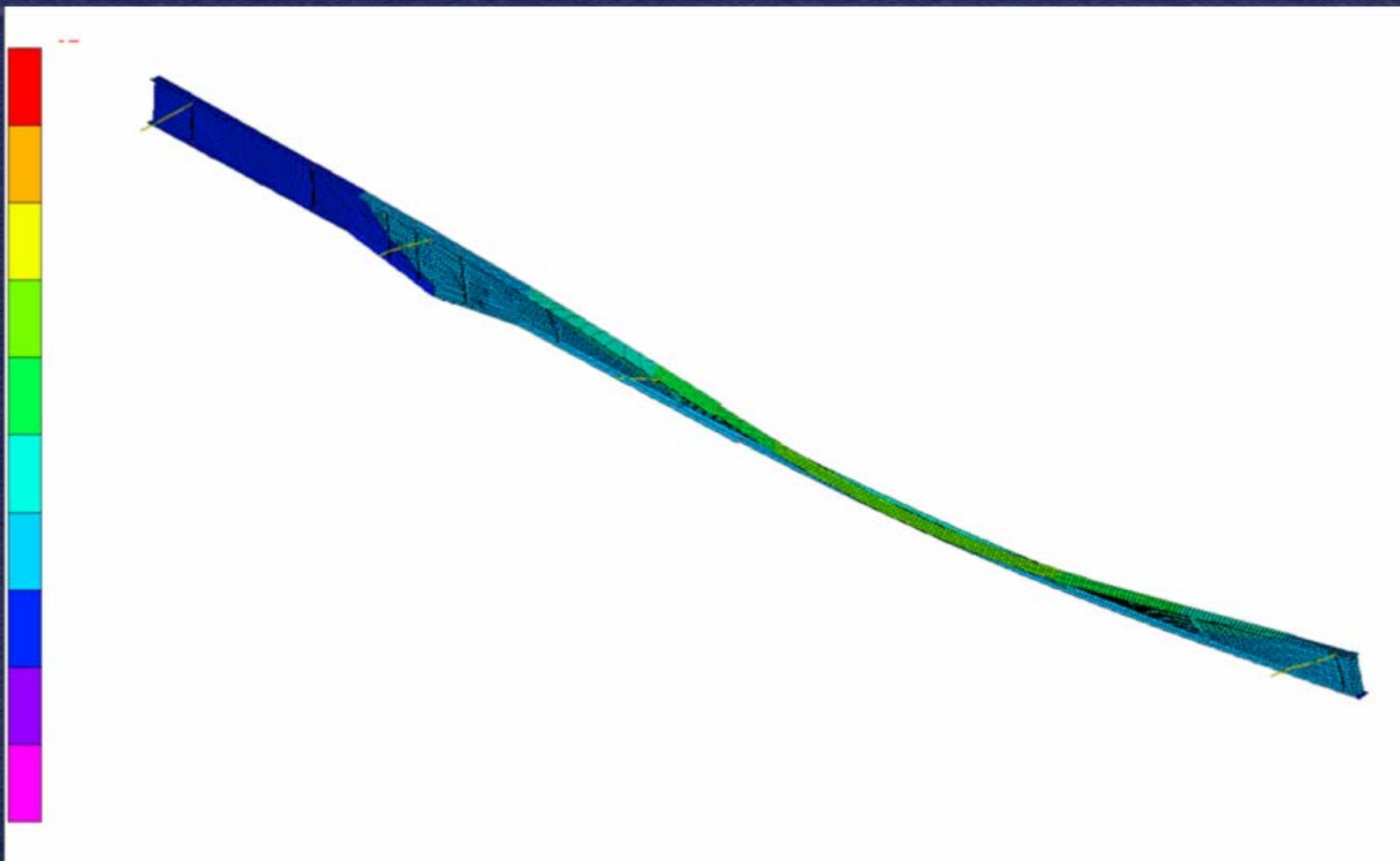


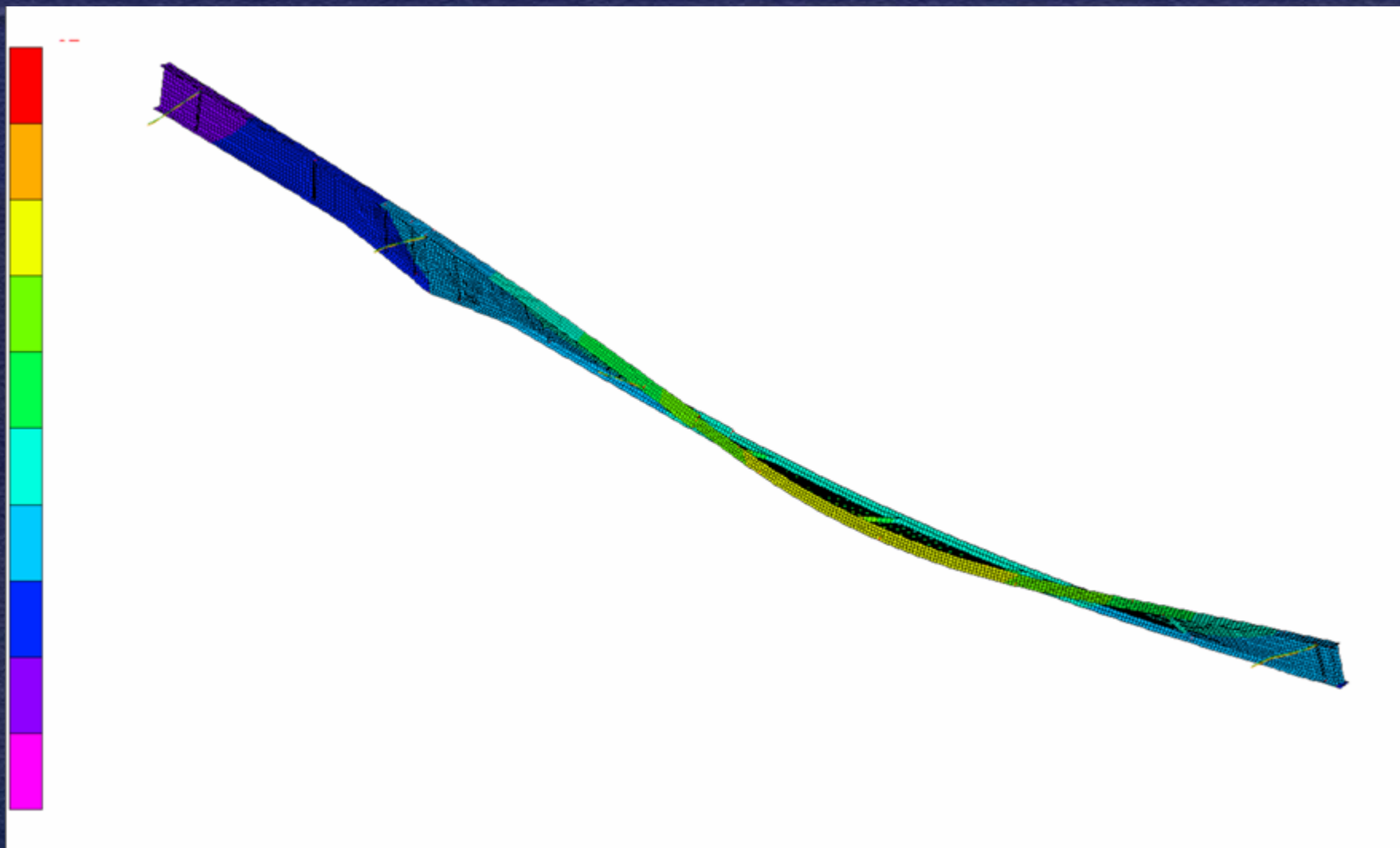


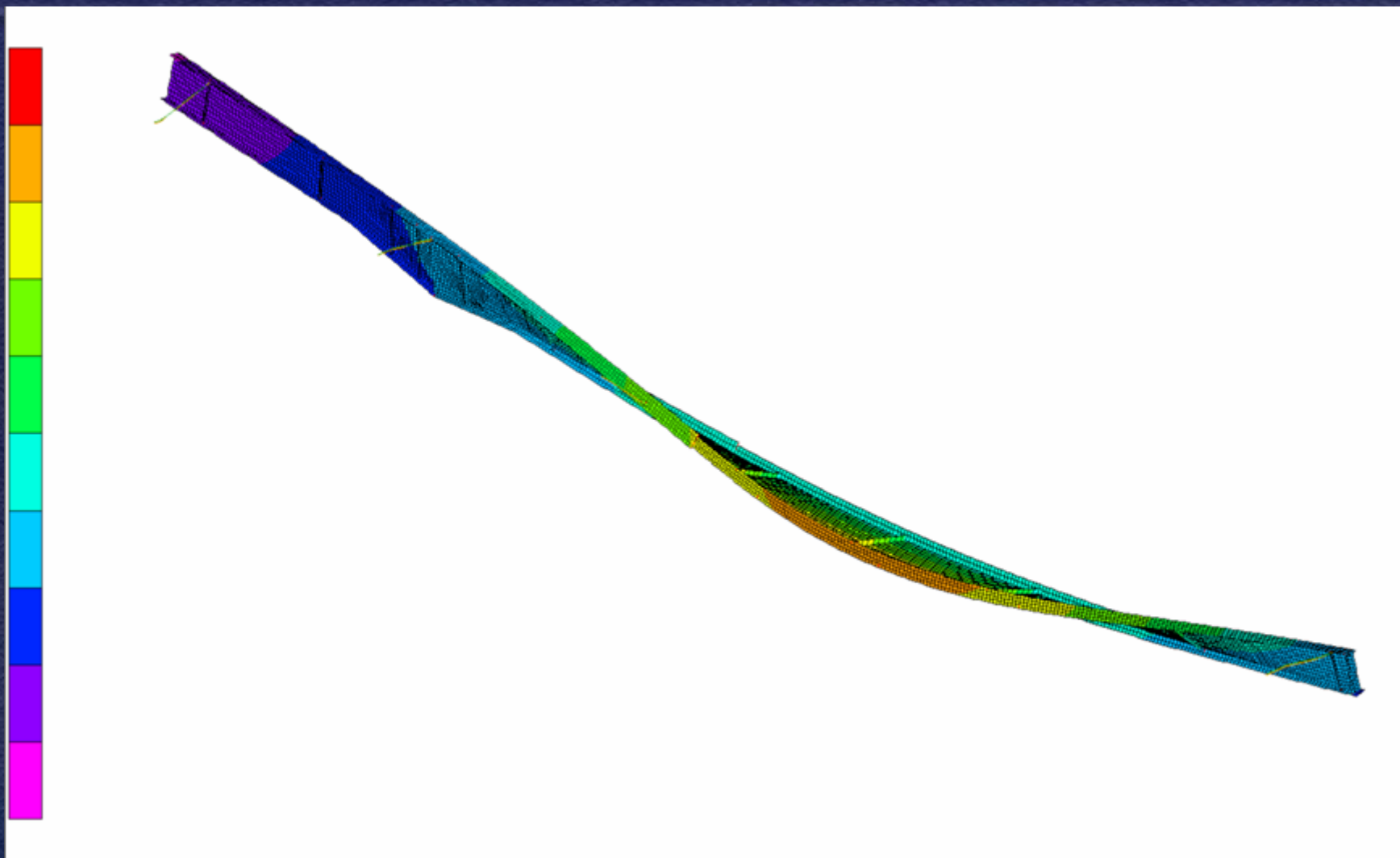


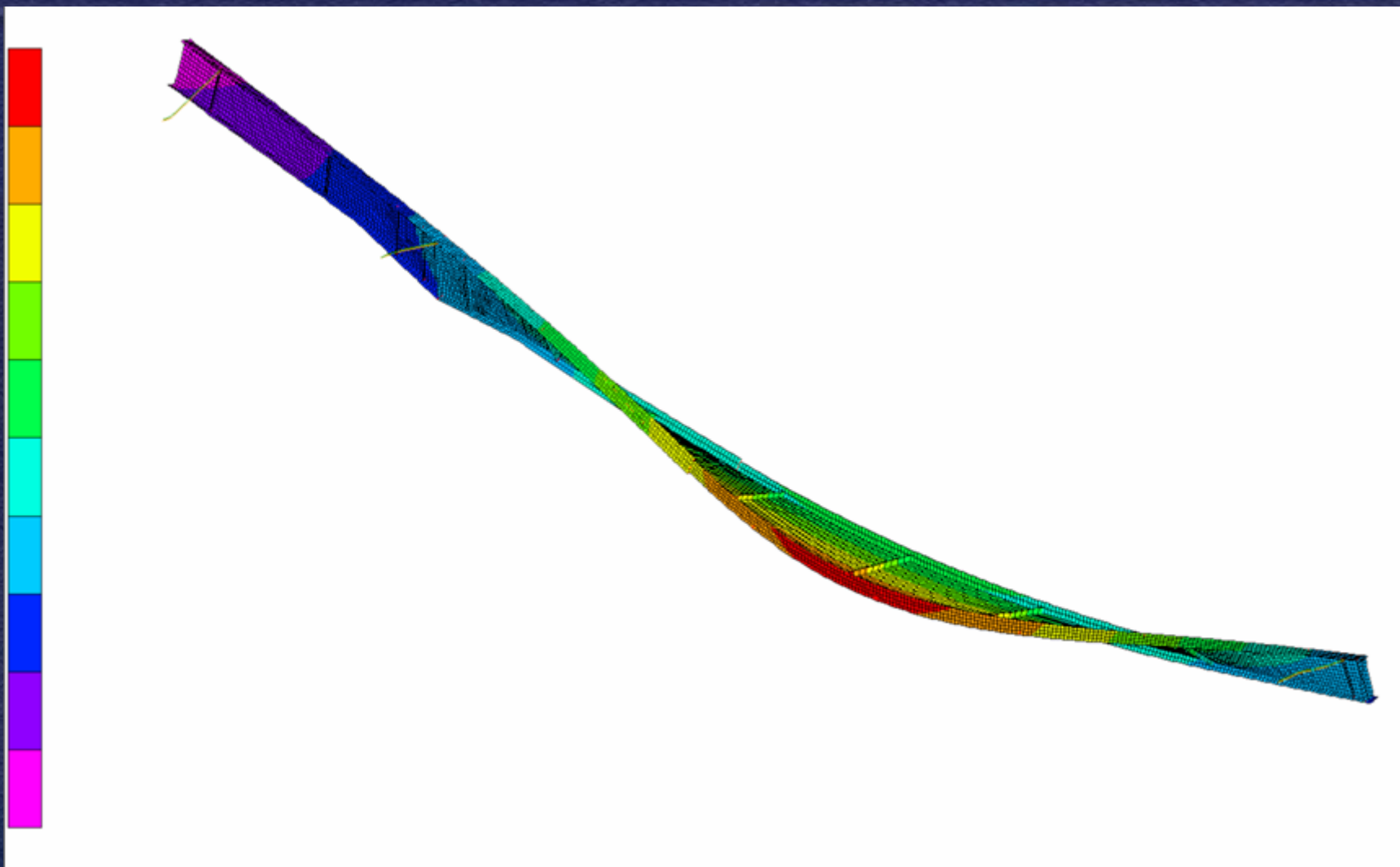


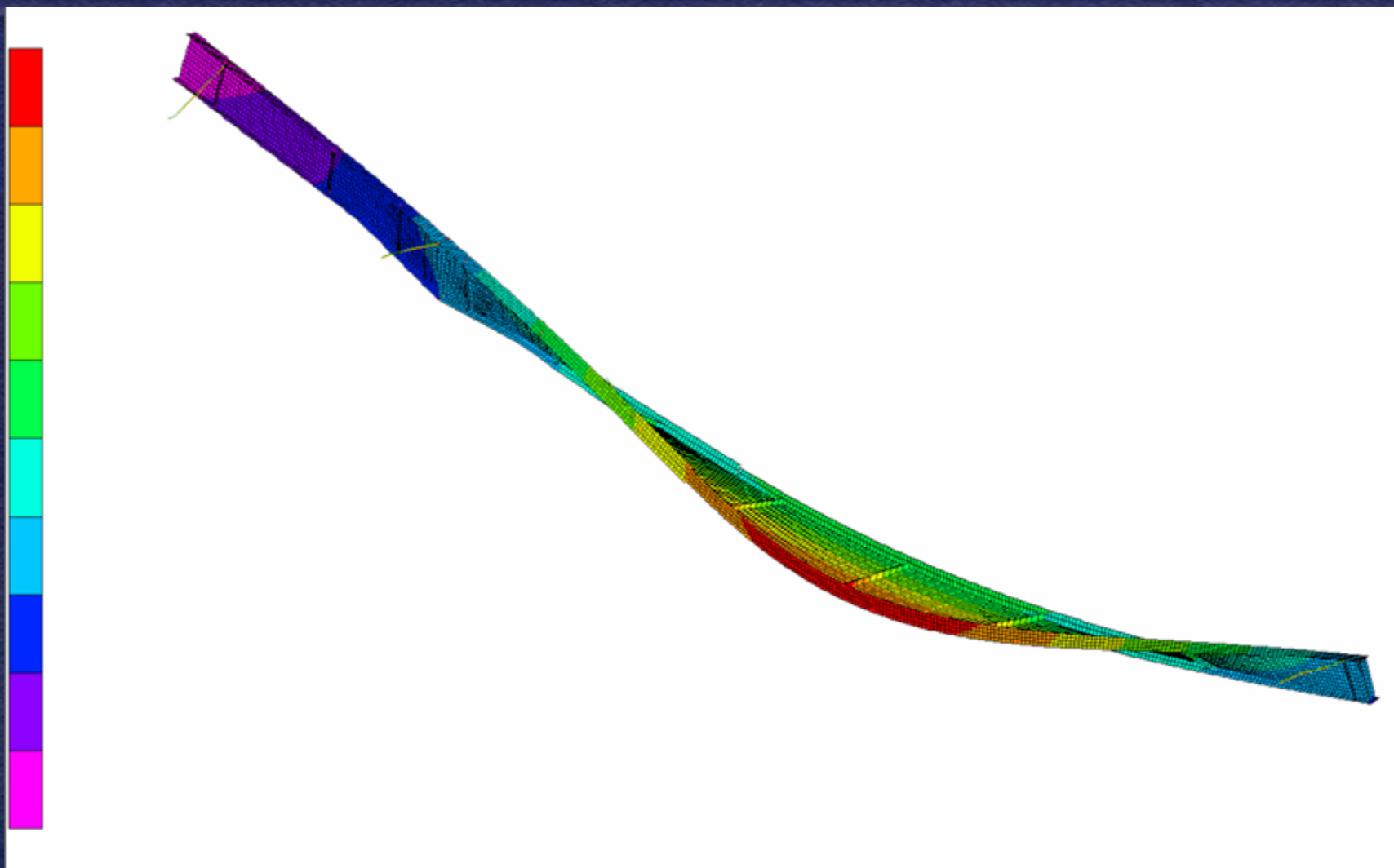












Summary

- Erection of the girder and installation of the bracing were inadequate
 - Out-of-plumb girder
 - Improperly installed bolts
- Resulted in an insecure bracing arrangement that was not adequate in the short or long term

Summary (Cont'd.)

- Bracing plan lacked forethought
- Original intention to set two girders
- No contingency plan for securing ONLY a single girder



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